



Tire Rolling Resistance for Light Vehicles, I: Selection of Tires and Tests for Rating System Development

John Harris, Transportation Research Center, Inc.

James D. MacIsaac Jr., USDOT - NHTSA

Larry Evans, Transportation Research Center, Inc.

Presented to California Energy Commission – Feb. 5, 2009

*Originally presented at Rubber Division, ACS
174th Technical Meeting, Louisville, KY, Oct. 14, 2008*

Tire Rolling Resistance Test Program



- **Testing conducted at two laboratories to evaluate lab-to-lab variability:**
 - Smithers Scientific Services, Inc. (SSS)
 - Akron Rubber Development Labs (ARDL)
 - Subcontracted to Standards Testing Labs (STL)
- **Five rolling resistance test methods evaluated**
 - Three SAE & Two ISO methods
- **Twenty five tire models included in study**
 - 600 tires total
 - 815 individual test results
 - Minimum 25 tires each group same or near same DOT code
 - Included Standard Reference Test Tires (SRTT),
 - (Tire Type “M14” - ASTM F2493-06, 225/60R16 Tire)



Laboratory Rolling Resistance Testing

■ Smithers Scientific Services, Inc.

- Force Machine
 - All 5 methods



■ Standards Testing Labs

- Torque Machine
 - SAE J2452
- Force Machine
 - SAE J1269 multi - SAE J1269 single
 - ISO 18164 - ISO 28580



Selecting a Test Method

■ Five Test Methods Evaluated

- SAE (USA) Rolling Resistance Tests
 - J2452 Coastdown
 - Auto manufacturers use for vehicle fuel economy calculations over a range of speeds
 - J1269 Multi-Point
 - Uses four or six sets of test conditions and allows calculation of rolling resistance at a “Standard Reference Condition (SRC)”
 - J1269 Single Point
 - Runs a single test at the SRC
- ISO (Global) Rolling Resistance Tests
 - 18164 Multi-Point
 - Four or five rolling resistance values based on four or five test conditions
 - 28580 Single Point (Draft International Standard) in ballot
 - Runs a single test



Selecting a Test Method



| Category | SAE J2452 Coastdown | SAE J1269 Multi-Point | SAE J1269 Single Point | ISO 18164 Multi-Point | ISO 28580 Single Point |
|----------------------------|----------------------------|----------------------------|------------------------------|--------------------------------------|--|
| Machine | 1.708 m | 1.708 m | 1.708 m | 1.708 m | >=1.708m |
| Measurement Method | Force, Torque, or Power | Force, Torque, or Power | Force, Torque, or Power | Force, Torque, Power, or Decel. | Force, Torque, Power, or Decel. |
| Surface | 80 Grit | 80 Grit | 80 Grit | Smooth Surface (80 grit optional) | Bare or Textured Surface |
| Speed | Multi | 80 km/h (50 mph) | 80 km/h (50 mph) | 80 km/h (50 mph) | 80 km/h (50 mph) |
| Pressure | Multi | Multi | +20 kPa (3 psi) Regulated | Multi | 210 kPa - SL capped 250 kPa - XL capped 100% LT Capped |
| Load | Multi | Multi P 90% & 50% | P 70% sw load | Multi P 50% & 90% | P 80% sw load LT 85% sw load |
| Reference Temp | 24°C | 24°C | 24°C | 25°C | 25°C |
| Break-in | 60 min | 30-60 min | 60 min | 30 min | 30 min/50 min |
| Lab Alignment Procedure | No | No | No | No | Yes |

Overview of 16 Passenger Tire Models

1 Mfg. - Goodyear
4 Sizes
1 Model - Integrity
+ 1 Runflat

Axis #2

1 Mfg. - Bridgestone
1 Size - P225/60R16
6 Tire Models

B15 Winterforce S

B10 Blizzak REVO 1 Q

B12 Potenza RE750 W

B14 Turanza LS-V

B11 Potenza RE-92A H

B13 Turanza LS-T

M14 Reference Tire ASTM SRTT S

D10 Cooper Lifeline Touring SLE H

R4 Pirelli P6 Four Seasons H

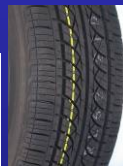
P5 Pep Boys Touring HR

M13 Michelin Pilot MXM4 H

Axis #1

Axis #3

4 Mfg.
1 Size - P225/60R16
1 Speed Rating - H



G9 P205/75R14 S

G10 P205/75R15 S

G8 225/60R16 S

G11 P225/60R17 S

U3 P225/60R17 T



Comparison of Single Point Rolling Resistance Tests



ISO 28580 (Draft)

- 1.708m or greater Test Machine
 - Not corrected to 2m in this study
- Force/Torque/Power/Deceleration methods
- Bare or Textured Surface
- 25°C Reference Temperature
- 80 km/h (50 mph)
- 80 Passenger / 80 LT % sidewall load
- 210 kPa Pass / 100% LT pressure
- Capped pressure
- NO break-in
- Lab Alignment Procedure

SAE J1269 Single (SRC)

- 1.708m Test Machine
- Force/Torque/Power methods
- 80 Grit Surface
- 24°C Reference Temperature
- 80 km/h (50 mph)
- 70% sidewall load
- @ +20 kPa (3 psi) Regulated
- 60 minute break-in (optional)



ISO 28580 (Draft) vs. SAE J1269 SRC



Disadvantages

ISO 28580 (Draft)

- Bare surface less accurate at high light truck tire loads
- Not a large database to date

J 1269 Single (SRC)

- Regulated pressure is different from highway usage
- Coefficient of Variation was 2.3

Advantages

- Harmonization - Being developed by ISO and Tire Industry as "World Standard"
- Least difference in labs studied
- Coefficient of Variation was 1.2

- Tire Industry has large data base of results from this test
- Database from J1269 Multi-Point can be used to calculate SRC result



ISO 28580 (DIS) Lab Alignment



- Includes 2 “Alignment Tires” for passenger being developed / defined by ETRTO
- Includes 2 “Alignment Tires” for light truck (C tire) being developed / defined by ETRTO
- Results corrected to 2 meter drum diameter
- Uses control tires to handle day-to-day, month-to-month variation, or out of calibration



Test Program Summary

- **Two laboratories were included in testing**
- **Five Test Methods Evaluated**
- **Twenty five tire models included in study**
 - Passenger tire rolling resistance range:
 - Force = 9.7 – 15.3 lbs
 - RRC = 7.3 – 11.6 ($\times 10^{-3}$)
 - Light truck tire rolling resistance range:
 - Force = 22.0 – 28.4 lbs
 - RRC = 8.5 – 11.0 ($\times 10^{-3}$)

